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ABSTRACT

The objective of this research was to forecast the potential impact of videodisc technology on Navy training in the period 1976-1986 by measuring and interpreting the opinions of a panel of experts. The DELPHI, a methodology for systematic solicitation and collation of informed judgments, was the primary research tool. It was concluded that the expected growth in videodisc technology was large enough to warrant an investigation of its uses in terms of increasing instructional productivity and reducing instructional costs. (Author/STS)

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VIDEODISC TECHNOLOGY USE THROUGH 1986: A DELPHI STUDY

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A preliminary research effort to investigate the diffusion of videodisc technology in diverse environments over a 10-year period was undertaken to determine disc availability for future Navy training requirements. The DELPHI, a technique for eliciting judgments, was used as the primary research approach. It was concluded that, by 1986, the use of audiovisual formats will have increased and the use of videodisc technology will have reached sufficient levels to warrant immediate instructional systems development procedures of videodisc technology.

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FOREWORD

This research was conducted in support of Exploratory Development Task Area ZF55.522.010 (Developments in Technology for Applications in Training and Education) under the sponsorship of the Chief of Naval Education and Training.

The cooperation of those who participated as panel members throughout the project is gratefully acknowledged. Special thanks are tendered to Donald Wylie, San Diego State University, and H. Dewey Kribs, formally at NAVPERSRANDCEN and now at Instructional Science and Development, for their assistance in carrying out this research, and to J. D. Fletcher, who provided the technical review.

J. J. CLARKIN
Commanding Officer

SUMMARY

Problem

Videodisc systems are currently being developed for use in entertainment and instruction. Specifications for such systems indicate several potential uses of videodisc technology for Navy training. To date (1976), videodisc systems have not been widely available, but they are expected to enter the marketplace on a large scale in 1977-79. Availability of hardware and software, as well as market impact, can determine the use of videodisc technology for training.

Objective

The objective of this research was to forecast the potential impact of videodisc technology on Navy training in the period between 1976 and 1986 by measuring and interpreting the opinions of a panel made up of experts in the development of videodisc technology.

Approach

The DELPHI, a methodology for systematic solicitation and collation of informed judgments, was selected to identify and evaluate issues regarding the future of videodisc technology. Issues were identified by asking panelists in Round One to predict changes in technology, education, etc., that they felt would occur by 1986 because of the introduction of the videodisc. From responses obtained, 136 prediction statements were developed and arranged under 11 prediction categories. In Round Two, panelists were asked to rate (1) the probability of each prediction statement occurring within the specified time frame and (2) their confidence in their probability rating, both on a five-point scale. Means, medians, standard deviations, and interquartile ranges were computed, using responses for each of the 136 prediction statements having high confidence ratings. In Round Three, prediction statements reaching high agreement were eliminated and others were rewritten or added. Responses were processed in the same manner as those for Round Two.

Round Four was the final round of the DELPHI exercise. In this round, panelists were asked to rate 151 prediction statements, which represented a compilation of every prediction that had been made since the beginning of the DELPHI exercise, except for those reaching high agreement. Responses were processed in the same manner as those for previous rounds. However, to determine final levels of agreement, the distribution of standard deviations for each prediction statement was computed, and Z-scores were derived from these distributions. The resulting distribution of Z-scores provided a method for ranking statements on a normal curve.

Four levels of agreement were defined, based on the normal distribution of Z-scores derived from prediction statements included in Round Four: (1) Consensus, (2) Tendency Toward Consensus, (3) Tendency Toward Disagreement, and (4) Disagreement.

Results

Of the 151 prediction statements included in Round Four, 22 (15%) indicated consensus; 48 (32%), tendency toward consensus; 55 (36%) tendency toward disagreement; and 26 (17%), disagreement. Most of the items reaching high agreement in Rounds Two and Three also indicated consensus. Based on these results, the prediction statements indicating consensus may be summarized according to their topic categories as follows:

1. Cultural Impact: No high consensus responses.

2. Entertainment Aspects: Film and broadcast producers will place greater restrictions on videodisc rights; there will be four-channel sound via videodisc; there will not be a reduction in paid attendance to "out-of-home" events; publishing houses will produce directly for videodisc.

3. Mass Communications: Videodisc periodicals will merge motion, still, print, and nonprint media; local broadcast stations will not be eliminated; videodiscs will assume an 'economically self-regenerating" position by 1986.

4. Technology: Videodisc systems will incorporate random access to 10^{15}-10^{17} bit memories, disc changers, CW and solid-state lasers, flat electronic display, and large-screen display.

5. Commercial Applications: Standardization will be achieved by market place elimination; motion picture reissues on disc will be less popular than videodisc periodicals; magnetic tape will be used where read/write capability is important; if two systems emerge, the less expensive medium will be used in homes and the more expensive, in institutions; the relative costs of all video record-playback machines (tape, cassette) will decrease.

6. Quality of Education: The gulf between highly educated and under-educated societies will not have widened; videodiscs will allow an increase in learning if educators are willing to use it for that purpose; educational uses of videodiscs will lag behind their availability.

7. Institutional Education: Videodiscs will facilitate the growth of open learning, individualized instruction, and audiovisuals used in nonlinear instructional design.

8. Noninstitutional Education: The physically limited will have more access to education; continuing professional education will be presented on discs; off-campus secondary education will be seen.

9. Educational Feasibility: Nonentertainment users will be more inclined to purchase videodisc hardware and software if the cost remains less than comparable videotape hardware and software.

10. Educational Media: Freeze frame, frame address, and fast random access will be necessary and sufficient for interactive branching systems; overall use of audiovisual formats will increase, videodiscs will engender more use of audiovisuals to supplement texts.

11. Library Applications: No high consensus responses.

Conclusions

The Navy can expect videodisc systems--in both optical and capacitance formats--to be available for use in Navy training by 1986. An increasing use of audiovisuals is also expected.

The diffusion of videodisc systems into environments other than instruction can be expected to reach sufficient magnitude to warrant immediate investigation of using videodisc technology for increasing instructional productivity and reducing instructional costs.

Recommendations

1. The Navy should assist in the development of optical videodisc systems since such systems are more suited to Navy training requirements.

2. The Navy should increase R&D investments in audiovisual instruction.

3. Investigations should be initiated to determine the relative instructional effectiveness of various media and to develop a methodology that accounts for individual differences and establishes optimal media combinations.

4. A systems approach should be developed that addresses the procedures, facilities, and costs of videodisc delivery systems, as well as the use of videodiscs for delivery and selection of appropriate intermediary instructional development media.

5. R&D should be conducted to determine how videodisc technology can be applied to storage of personnel file information, technical reference information, and videodisc automated hard-copy transfer that can be updated periodically.

6. Operational investigations should be initiated on the potential use of videodisc technology for distributed (especially shipboard) consolidation of file and technical reference information, presentation of entertainment, and delivery of instruction.

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INTRODUCTION

Problem

A wide variety of Navy training requires the use of audiovisual display systems. Systems currently in use include such information presentation devices as videotape players, slide projectors, educational television, audiotapes, random-access devices for short audio messages, and computer-assisted terminals with alphanumerics and interactive graphics. One such system currently being developed by the Navy Personnel Research and Development Center is the Computer Controlled Multimedia System $(CM)^2S$, which combines the functional characteristics of all these individual devices and channels each media type to one receiving location. The increasing need for and types of such systems in Navy training has resulted in increased needs for operator and maintenance training, which has, in turn, increased Navy training costs. Thus, the Navy has a requirement to conduct a systematic data-based evaluation of new developments in display technology so that the cost effectiveness of Navy training can be maintained at an optimum level and maximum advantage can be taken of promising developments.

Background

The instructional effectiveness of display systems depends on a number of factors. First, the system should be able to interact with the student. The interaction includes initial instruction, student responses, feedback concerning the student's knowledge state, interruption of instruction to allow the student to practice and obtain further information, remedial instruction at difficulty points, questioning (on the part of both student and instructor), and final instruction necessary to obtain the desired level of knowledge. Unfortunately, with the exception of computer-assisted instruction, none of the display systems listed above allow interaction except on a gross basis.

Second, the system should provide for information presentation by various media (e.g., still or motion visuals, auditory messages, and tactile information), since it is recognized that different media are appropriate for different learning situations and for different people. For example, in training aircraft pilots, one might use visual displays (still and motion) of the cockpit instruments, auditory input that simulates communications among crew members and from control towers, and response devices that simulate the tactical requirements of the actual task and cause appropriate changes in the visual/auditory presentations.

Third, the system should allow individualization of instruction. That is, when a student makes a response, he should be able to select the presentation media appropriate for his input response, cognitive style, and level of proficiency.

The videodisc, an innovation in audiovisual technology, represents a promising tool that can satisfy the requirements of interaction, multimedia environments, and individualized instruction if its design specifications include (1) electronic addressability for each frame, (2) random access, (3) freeze-frame mode, and (4) the capability to store the above media characteristics on a single inexpensive receiving source. These design

features, in combination with a microprocessor, would allow random-access selection of short or long audio messages, color video (stills or motion), animation, alphanumerics, and graphics. This, in turn, would result in (1) a decreased load on the computer system for processing and storage, (2) faster access, (3) simplified switching, (4) portability, and (5) substantially more information storage at a much reduced price.

At this point, however, videodisc technology is still in a developmental stage, with videodisc systems being developed by private industry primarily for entertainment uses. Instructional hardware and software for videodiscs are not yet available. Those systems now in the final stages of development are listed in Table 1. A review of the characteristics of these systems indicates that some are more capable of combining media than others (Bennion & Schneider, 1975; Bull 1976). Those that use physical contact between the stylus and disc to scan information (TED, RCA) eliminate potential for including electronic addressibility, random access, and freeze-frame mode features, since they only permit linear playback. The systems that use an optical means of scanning information do permit incorporation of these features. In addition, optical videodiscs have the advantage of a longer operating life than contact discs, which can result in reduced downtime and, subsequently, decreased instruction costs.

What design features are incorporated into the emerging videodisc system depends largely on the marketing goals of the manufacturers and the market impact of videodiscs. While some manufacturers may initially attempt to establish ties with the educational/industrial market, others will concentrate on the larger "home" market in order to recoup R&D investments (Glenn, Note 1). The availability of audiovisual hardware and software for training frequently depends on the success of such devices in mass markets. That is, an innovation such as super eight film is available as an instructional tool largely because it finds acceptance among mass users such as amateur photographers. Super eight is available for training because photographers accepted it as an improvement to regular eight and as a substitute for other motion film formats in many applications. Electronic Video Recording (EVR) and Cartrivision, video cassette systems, whose marketing goals were similar to those of videodiscs, are not available because they did not find acceptance as home entertainment systems. Thus, it appears that societal needs for specialized videodiscs will determine incorporation of design features that, in turn, will determine whether videodisc systems will have an impact on Navy training. Those persons who are closely involved with the research and development of videodisc systems are most likely to be aware of the availability of design features and probable market impact.

Objective

The objective of this research was to determine the potential effects of videodisc technology on Navy training during the period from 1976 to 1987 by soliciting and interpreting opinions of a panel identified as having expertise in the development of videodisc systems.

Table 1

Basic Videodisc Systems Comparisons

Videodisc System	Type of Playback	Linear Playing Time	Electronic Address	Random Access	Freeze Frame	Estimated Initial Market Date
Digital Recording	Optical laser-scan	30-60 minutes per disc	Yes	Yes	Yes	Unknown
I/O Metrics Cooperation	Optical 10W light	30 minutes per disc	Yes	Yes	Yes	1977
TED[a] (Telefunken-Decca)	Contact Diamond Stylus	10 minutes per disc	No	No	No	1974
Philips-MCA (N.A. Philips-MCA. Inc.)	Optical laser-scan	30 minutes per disc	Yes	Yes	Yes	1977
RCA	Contact Capacitance probe	30 minutes per side (2 sided disc)	No	No	No	1977
Thomson - CSF[a]	Optical laser-scan	30 minutes per disc	Yes	Yes	Yes	1978
Zenith	Optical laser-scan	30 minutes per disc	Yes	Yes	Yes	1979

Note. Data were updated by personal interviews with manufacturers and are subject to change.

[a]625 scanning line television standard.

APPROACH

DELPHI Forecasting Technique

DELPHI, a method developed by Helmer and Dalkey (1963) of the Rand Corporation for systematically soliciting and collating expert opinions, was used as the primary research vehicle for this project. This approach was considered superior to the panel discussion approach, since opinions or predictions usually represent the bias of a person or group. Helmer (1966) noted that opinions derived from panel discussions are subject to the bandwagon effect, specious persuasion, and the unwillingness on the part of an individual to abandon a publicly expressed opinion. Additionally, Turoff (1970) noted that: (1) it is often difficult for a group to meet due to time or distance constraints, (2) it may be desirable to preserve anonymity of the conferees, (3) the group may be too large for an effective conference telephone call or committee exchange, (4) the group may be interdisciplinary to the extent that a structured or refereed communication mode is more desirable than a committee or panel approach, and (5) disagreement among group members may be too severe for meaningful face-to-face exchange of views.

DELPHI is applicable to any decision-making process whenever policies and plans have to be based on informed judgment (Helmer, 1966). It has frequently been used in the area of technological forecasting, especially when it is necessary to clarify issues and reevaluate objectives for activities conducting long-range research and development (R&D) projects (Cyphert & Gant, 1970). Typically, a DELPHI exercise consists of four to five carefully designed sequential iterations or rounds, interspersed with information feedback. The iterations allow the DELPHI panel to reconsider factors they might have inadvertently neglected, and to give due weight to those they may have initially dismissed as unimportant. Thus, the DELPHI approach of systematically extracting expert opinions was deemed an appropriate method for forecasting the future applicability of videodisc technology to Navy training needs.

DELPHI Panel Assembly

A design team comprising three researchers knowledgeable of videodisc technology was identified. The team reviewed background data of potential participants in the DELPHI project to determine whether candidates possessed sufficient expertise in telecommunications and videodisc technology. Among the selection criteria were: (1) authorship of publications on aspects and applications of videodiscs, (2) direct involvement in the manufacture of videodisc hardware and software, and (3) membership in professional organizations with declared interests in the development of videodisc technology. An attempt was made to assemble the DELPHI panel from individuals at senior levels of responsibility within their fields.

The team initially selected 127 candidates and sent them a personal invitation to participate on the DELPHI panel. Along with the invitation, candidates were sent (1) a description of the purpose and scope of the project and of DELPHI methodology, (2) a bibliography on DELPHI for their use in the event they wished to make further inquiries, (3) an authorization slip that they were requested to sign if they agreed to participate, and (4) a franked, preaddressed envelope for returning the authorization slip. Of the total, 81 agreed to participate, 24 declined, and 22 failed to respond.

Since it was considered that a larger panel was desirable, the design team identified 14 additional candidates and invited them to participate at the Round One phase of the project. The selection of additional candidates early in the iterative sequence is an option provided in DELPHI methodology (Kimble, 1968). Of the total of 14, 11 agreed to participate in one or more of the succeeding rounds, as their schedule permitted; 1 declined; and 2 failed to respond. Thus, the total DELPHI panel comprised 92 individuals. Since all appropriate individuals were contacted by the design team, the final panel comprised a population of experts in videodisc technology rather than a sample.

Panel members can be roughly categorized as corporate developers, educators, engineering practitioners, or media practitioners. The corporate developers represented every company within the United States that is developing a videodisc system, as well as companies concerned with related fields such as audiodiscs and read-write video technologies. The educators were primarily specialists in media-related fields such as instructional design for television and media research, plus several educational psychologists and professors of education. The engineering practitioners were concerned with electrical, video (technical), photo-optics, or computer science technologies. Finally, the media practitioners were audiovisual specialists, media producer-programmers, educational television experts, or mass communications experts. Several panel members were experts in more than one discipline; that is, some corporate developers were also engineers and many educators were also active media practitioners.

Procedure

The entire DELPHI exercise, which consisted of four rounds,[1] was conducted by mail. Upon receiving their materials, participants were asked to respond within 10 days. However, due to the length of each questionnaire, late returns were accommodated. Telephone numbers of the design team were provided to participants to facilitate communications in the event questions arose.

Although the participants were asked to refrain from discussing the issues with each other, they were free to use any other informational sources. In addition, they were asked to respond subjectively, as individuals, rather than as representatives of a specific activity.

The response materials returned from participants in each round were summarized, statistically analyzed, and reformatted to serve as feedback to participants in the succeeding round. Each round required approximately 2 months to complete, including the time required for correspondence and for analyzing the responses. A round-by-round procedural description is described below.

Round One

Round One materials were mailed to the 81 respondents who originally agreed to participate on the DELPHI panel. Materials included additional project information, participation instructions, Questionnaire I and specific instructions for completing it, and a preaddressed, franked envelope for returning the completed questionnaire.

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[1]General instructions and questionnaires provided to participants during the DELPHI exercise are available upon request to the Navy Personnel Research and Development Center (Code 304).

Basically, Questionnaire I asked panelists to predict at least three changes (e.g., in technology, in education, or in the socioeconomic, political, and cultural spheres), that they felt, based on their knowledge or experience, would occur by 1986 because of the introduction of the videodisc.

Responses were received from 50 (61%) of the original 81 panel members. Predictions were checked for duplication and edited, and related predictions were grouped together by the design team. A total of 136 such groupings was identified. These groupings were then arranged under 11 prediction categories, and a condensed prediction statement was prepared for each grouping. The 11 prediction categories and the number of groupings (and, thus, prediction statements) within these categories are listed below:

1. Cultural Impact--8.
2. Entertainment Aspects--15.
3. Mass Communications--11.
4. Technology--16.
5. Commercial Applications--25.
6. Quality of Education--8.
7. Institutional Education--10.
8. Noninstitutional Education--10.
9. Educational Feasibility--8.
10. Educational Media--19.
11. Library Applications--6.

Round Two

The questionnaire for Round Two consisted of (1) the groupings of related predictions and (2) the condensed prediction statements prepared for each grouping arranged under the 11 prediction categories. It was sent to the original 81 panel members, plus four others who agreed to participate in Round Two.

Panelists were directed to rate the probability of each prediction statement occurring within the specified time frame on a five-point Likert-type scale, with 1 meaning "very improbable," and 5, "very probable." Further, they were asked to "self-rate" their confidence in their probability ratings, based on their professional experience, on a five-point scale, with 1 meaning "very uncertain," and 5, "very certain." If they felt a prediction statement was misleading, they could rewrite it and then make their probability and confidence ratings. Finally, they were encouraged to comment on any judgments in which they felt confident and to suggest additional prediction statements that they felt should be included in Round Three.

Of the 85 questionnaires mailed for Round Two, 56 (66%) were completed and returned. Helmer (1967) demonstrated that an improved reliability forecast was most likely to occur when using only those probability ratings that were rated highly on the confidence scale by the individuals who made those ratings. Therefore, the probability ratings obtained were scanned to identify those that were rated 3, 4, or 5 on the confidence scale. Means, medians, standard deviations, and interquartile ranges were then computed for each of

the 136 prediction statements, using only those probability rankings that were rated highly on the confidence scale. In an effort to avoid redundancy, the design team decided that those statements that had a mean and median that were either 4.2 and above or 1.8 and below reflected high agreement and should be eliminated from further rounds. Thus, the 17 statements that met this criterion were removed from subsequent iterations.

Round Three

Material provided for Round Three included statistical feedback (i.e., frequency distributions, medians, and interquartile ranges) for each prediction statement included in the previous round. Materials were sent to the original 81 panelists, plus 9 others who agreed to participate in Round Three.

Questionnaire III contained 117 prediction statements arranged under the same categories as those in Questionnaire II. Selected comments received from Round Two were condensed and integrated with the prediction statement to which they referred. Several statements were reworded or recategorized according to panelist commentary, and several new predictions appeared for the first time.

Panel members were directed to provide probability ratings for each statement and to indicate their confidence in those ratings as they had done in Questionnaire II. In addition, panelists were urged to comment on the responses, to express reasons for their own (possibly extreme) responses, and to provide additional predictions for the next round.

Of the 90 questionnaires mailed for Round Three, 57 (61%) were completed and returned. Questionnaire III responses were processed in the same manner as those in Questionnaire II. Eleven statements were identified as reaching high agreement and were eliminated from the next (and final) questionnaire.

Round Four

Round Four was the final round of the DELPHI exercise. The questionnaire provided for this round contained 151 prediction statements, which represented a compilation of every prediction that had been made since the beginning of the questionnaire sequence, excluding those that had reached high agreement during Rounds Two and Three. Again, selected comments obtained from Round Three were integrated with the prediction statements to which they referred, and several statements were reworded and recategorized. In addition, several statements that had previously referred to multiple concepts were divided into several statements. Thus, several predictions appeared for the first time.

Under each prediction statement that appeared in Questionnaire III (except for the 11 that reached high agreement), a bar graph was inserted that showed the interquartile ranges and the median computed for that statement. The design team felt that this statistical feedback would be helpful to panelists in making their final probability ratings.

Round Four materials were sent to the 81 original panelists, plus 11 others who had agreed to participate in the final round. Panelists were asked to provide probability ratings for each prediction statement (using the statistical data provided where appropriate) and to indicate their degree of confidence in their ratings as they had done previously. In addition, in order to enable the design team to interpret low probability ratings, they were asked to predict whether the prediction would ever occur and, if so, when. This "probability-ever" rating option was included because several participants in previous rounds had indicated that they had assigned low probability ratings to various prediction statements, not because they felt the prediction would not occur but, rather, because they felt it would occur beyond 1986.

Fifty-five (60%) of the final questionnaires were completed and returned. Responses obtained were processed in the same manner as those obtained in Rounds Two and Three; that is, the probability ratings receiving high confidence ratings were identified and used to compute the mean, median, and standard deviation for each prediction statement.

Determining Levels of Agreement

By treating the normal distribution of standard deviations as separate scores and by assigning a standard (Z) score to each, levels of final agreement or disagreement among panel members can be more clearly understood. Thus, the distribution of all standard deviations was computed separately for prediction statements included in Questionnaires II, III, and IV. The mean (M) and standard deviation(s) of standard deviations for statements in Questionnaire II were 1.071 and .186 respectively; in Questionnaire III, 1.086 and .178; and in Questionnaire IV, 1.061 and .150. A basic assumption of the DELPHI procedure is that participant responses will merge with each successive round. Support of this assumption was provided by the overall decrease in standard deviations in Questionnaires II, III, and IV.

The standard (Z) scores derived from the distribution of standard deviations for the three questionnaires are shown in Table 2. Since statistics of statistics tend to distribute normally, the resulting distribution of Z-scores provided a method of ranking prediction statements on a normal curve.

Table 2

Z-Scores Derived from Standard Deviation Distributions

Questionnaire II		Questionnaire III		Questionnaire IV	
Std. Dev. Dist. (s = .186)	Z-Score Derived	Std. Dev. Dist. (s = .178)	Z-Score Derived	Std. Dev. Dist. (s = .150)	Z-score Derived
.513	-3.000	.552	-3.000	.611	-3.000
.699	-2.000	.730	-2.000	.761	-2.000
.885	-1.000	.908	-1.000	.911	-1.000
1.071	M	1.086	M	1.061	M
1.257	+1.000	1.264	+1.000	1.211	+1.000
1.443	+2.000	1.442	+2.000	1.361	+2.000
1.629	+3.000	1.620	+3.000	1.511	+3.000

The following four levels of agreement were defined, based on the normal distribution of Z-scores derived for prediction statements in Questionnaire IV:

1. Consensus (general agreement), when the Z-score is -1.000 or beyond (i.e., higher negative deviation).

2. Tendency Toward Consensus, when the Z-score is between -1.000 and 0.00. A score of .500 separates high and low levels of agreement within this level.

3. Tendency Toward Disagreement, when the Z-score is between 0.00 and +1.000. A score of .500 separates high and low levels of disagreement within this level.

4. Disagreement, when the Z-score is +1.000 or beyond (i.e., higher positive deviation).

RESULTS

Final Levels of Agreement

Of the 151 prediction statements included in Questionnaire IV, 22 (15%) indicated consensus; 48 (32%), tendency toward consensus; 55 (36%), tendency toward disagreement; and 26 (17%), disagreement. The statements falling under the four levels of agreement are shown in Tables 3 through 6. As indicated previously, the Z-score was the principal statistic used to determine levels of agreement; a high negative Z-score (-1.000 and beyond) indicates consensus and a high positive Z-score (+1.000 and beyond) indicates disparity of opinion. The response mean indicates agreement or disagreement with the prediction statement; a high mean indicates agreement and a low mean, disagreement. The most salient statements are, therefore, those with high negative Z-scores and high or low means and those with high positive Z-scores and means close to 3.0.

The following are two examples of how responses to the various statements were interpreted: In the first level of agreement, consensus (Table 3), no statement under the prediction category Cultural Impact reached consensus. The first item to reach consensus (Z = -1.000 and beyond) was prediction statement number 10 under Entertainment Aspects. The mean of 3.765 ("probable") and Z-score of -1.168 indicate that the panel generally agreed that, by 1986 film and broadcast producers will place greater restrictions and higher costs on videodisc rights for software in order to be competitive with the videodisc. In the next level of agreement, tendency toward consensus (Table 4), statement number two under Cultural Impact was categorized as a "high" tendency toward consensus (Z = -.999 to -.500) with the Z-score at -.763 and the mean at 4.096. Here it can be said that, although the panel did not generally agree, there was a moderately high tendency toward consensus that it will be probable by 1986 that "institutions (government, industry, arts, sciences) will see the videodisc as a communications tool capable of public cultural enhancement."

Table 7 and 8 list the "high agreement" statements in Questionnaires II and III respectively that were eliminated from further iterations. As indicated previously, these statements were considered as reaching "high agreement" if they had a mean and median that were either 4.2 and above (high probability) or 1.8 and below (low probability). When Z-scores were computed for these statements, it was found that a large majority of them met the criterion for consensus. However, the fact that eight of these high agreement statements (five in Table 7 and three in Table 8) did not meet this criterion indicates that it did not adequately account for "deviationist" opinions.

Table 3

Round Four Prediction Statements Indicating Consensus

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Entertainment Aspects					
10[a]	Film and broadcast producers will place greater restrictions and higher costs on videodisc rights for software in order to be competitive with the videodisc.	3.765	3.854	-1.168	.885
7[a]	There will be four-channel (quadraphonic) sound via videodisc.	4.098	4.211	-1.069	.900
Mass Communications					
6[a]	Videodisc periodicals will merge motion and still visuals, print and nonprint media.	4.020	4.071	-1.434	.845
10	Videodisc systems will take a general "economically self-regenerating" societal position as established mass communication media.	4.140	4.237	-1.355	.857
Technology					
13[a]	Random-access memories with 10^{15} - 10^{17} bits will be available with matrix information regimens. (Videodisc technology assumed.)	3.556	3.475	-1.647	.813
12[a]	Videodisc changers will be available by 1986.	4.140	4.286	-1.195	.881
3[a]	Both CW gas lasers and solid-state lasers will be in use.	3.378	3.295	-1.162	.886
Commercial Applications					
31[a]	Given the availability for purchase of a videotape recorder/player and a videodisc player and a sufficient quantity and diversity of programs for each, a consumer interested in entertainment will be more inclined to purchase the videodisc system when it is 1/3 the price of a videotape system.	4.729	4.824	-3.490	.536
4[a]	Standardization (compatible systems) will be achieved by market place process of elimination.	4.245	4.268	-2.193	.731
5	Standardization (compatible systems) would ensure videodisc as a component in some (0-25%) TV sets sold by 1986.	4.462	4.661	-1.714	.803
17[a]	More than 5% of American homes will own videodisc players by 1986.	3.961	4.050	-1.414	.848
18	The current marketing concept of ownership of existing motion picture titles on videodisc will be less popular to consumers than the mass communication (e.g., volatile periodical video magazine) concept.	3.255	3.250	-1.281	.868

[a]Relevant to Navy training requirements.

Table 3 (Continued)

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, n=.150)
Commercial Applications (Continued)					
10[a]	The relative costs of all video record-playback machines (tape, cassette) will decrease.	4.275	4.291	-1.241	.874
6	Standardization (compatible systems) will encourage formations of production companies.	3.981	4.071	-1.095	.896
21	Most people will prefer the purchase of two-way cable (over videodisc).	2.235	2.111	-1.021	.907
Quality of Education					
4[a]	The educated societies and individuals will have widened the gap between them and the uneducated causing greater "gulfs" in society.	2.673	2.684	-1.235	.875
2[a]	Educational uses of videodisc will lag behind videodisc availability.	4.151	4.232	-1.162	.886
Institutional Education: **Teaching Strategies**					
2[a]	Videodisc will facilitate the growth of open learning and individualized instruction.	4.415	4.478	-2.844	.633
3[a]	Audiovisuals on the videodisc will be used in a nonlinear instructional design.	3.863	3.926	-1.734	.800
Noninstitutional Education					
4	Off-campus credit courses by videodisc will be available in some secondary schools	3.804	3.926	-1.567	.825
Educational Feasibility					
15[a]	Given the availability for purchase of of videotape recorder/player and a videodisc player and a sufficient quantity and diversity of programs for each, an individual interested in a use for instruction, training, and other non-entertainment applications will be more inclined to purchase the videodisc system when it is: 1/3 the price of a videotape system.	4.630	4.767	-2.539	.679
Educational Media: **Computer-Based Instruction**					
3[a]	Freeze frame, frame address, and fast random access will be necessary and sufficient for interactive branching systems.	4.000	4.033	-2.213	.728

[a]Relevant to Navy training requirements.

Table 4

Round Four Prediction Statements Indicating Tendency Toward Consensus

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Cultural Impact					
2	Institutions (government, industry, arts, sciences) will see the videodisc as a communications tool capable of public cultural enhancement.	4.096	4.212	-.763	.946
1	New life-style interests will be available to millions via videodisc.	4.019	4.190	-.267	1.028
6[a]	Some balance and reconciliation between public and private, general and esoteric interests and their pursuits.	3.259	3.182	-.011	1.059
Entertainment Aspects					
5	Present small audience TV programming, e.g., symphony, ballet, opera, will have been eliminated by comparable videodisc programming.	1.796	1.533	-.689	.957
12[a]	Programming quality will be directly related to rising production costs in terms of production quality.	4.042	4.184	-.623	.967
13	"Short playing" videodisc records will outsell the "long playing" ones (one-disc album versus multiple-disc).	3.458	3.500	-.483	.988
9[a]	Audience involvement theatre will be explored on videodisc branching points.	3.367	3.295	-.443	.994
3	Entertainment quality of programming will (by necessity) be low due to factors of quantity and mass appeal.	2.231	2.056	-.257	1.022
4	There will be a lack of "limited audience" videodisc programming, i.e., symphony, etc.	2.118	1.942	-.058	1.052
Technology					
2[a]	There will be greater precision and efficiency in maintenance technology (i.e., aircraft maintenance) utilizing audiovisual material stored on videodisc.	4.019	4.107	-.949	.918
5[a]	Two-dimensional dense storage techniques in optical, magnetic, and holographic media will have emerged.	3.682	3.643	-.842	.934
4[a]	Solid-state lasers will replace other readout devices.	3.340	3.240	-.809	.939
15[a]	Video dropout problems will have been largely eliminated by improved materials technology.	3.957	4.053	-.703	.955
6[a]	Work in three-dimensional storage will be evident.	3.628	3.706	-.397	1.001
10[a]	Videocard technology will demonstrate benefits over the videodisc.	2.553	2.575	-.290	1.017

[a]Relevant to Navy training requirements.

Table 4 (Continued)

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Commercial Applications					
19	There will be more than one accepted home videoplayer format by 1986, but not more than three.	3.558	3.722	-.962	.916
22	Most people will prefer the purchase of home video recorders (over videodisc).	2.333	2.161	-.723	.952
28	Given the beginning availability of at least one videodisc system and a sufficient quantity and diversity of accompanying programs intended for entertainment use by the close of 1976, the period in which the accumulated number of videodisc players of that same or a compatible system in the hands of users will reach 2 million or more will be: 1986.	4.408	4.710	-.556	.977
23	Until standardization occurs, the public will hold back from large-scale purchase of videodisc players.	4.000	4.135	-.530	.981
26	Given the beginning availability . . . the period in which . . . videodisc players will reach 2 million or more will be: 1979-80.	2.059	1.920	-.483	.988
12[a]	Cost per videodisc program will exceed current market projections.	3.320	3.208	-.277	1.019
1	Standardization (compatible systems) will precede any subsequent technological achievement (i.e., will retard broad-scale commercial utilization of subsequent technological developments).	3.020	3.000	-.137	1.040
Quality of Education					
1[a]	The most immediate impact of videodisc will be in education.	2.434	2.196	-.211	1.029
3	Discs will be produced to aid in developing countries.	3.750	3.909	-.097	1.046
Institutional Education: Teaching Strategies					
1[a]	Teachers will integrate audiovisual instructional materials to a somewhat greater degree than is currently being done--given videodisc availability.	3.849	3.983	-.882	.928
Role of the Teacher					
5[a]	A new form of learning-counseling center will be available for student guidance and evaluation.	3.423	3.500	-.689	.957
3[a]	Teachers will play greater roles as learning resource advisors rather than as information disseminators because of videodisc impact.	3.231	3.262	-.516	.983

[a]Relevant to Navy training requirements.

Table 4 (Continued)

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Institutional Education					
Role of the Teacher (Continued)					
4	The videodisc will stimulate the formation of new or reorganized specialized groups of design and production personnel at some institutions.	3.692	3.780	-.270	1.020
1[a]	There will be a visible change in the role of the teacher due to the introduction of the videodisc.	2.358	2.200	-.264	1.021
7	Videodisc will be considered by educators as "just another delivery system" in the conventional school setting.	3.792	3.966	-.230	1.026
6	Teacher education probably will use videodisc for teacher training, including topics such as how to apply videodisc uses to education.	3.765	3.938	-.197	1.031
Noninstitutional Education					
1[a]	There will be a significant shift from centralized education to decentralized education.	2.360	2.145	-.929	.921
7	Life will be enhanced by enjoyment of "personal" education and growth.	3.688	3.870	-.596	.971
3[a]	Proprietory schools and educational industries will develop beyond present levels.	3.776	3.920	-.503	.985
2[a]	Off-campus courses in a videodisc package will be given for credit on a general scale.	3.686	3.875	-.470	.990
Educational Feasibility					
5	Low disc costs will encourage more and better quality programs for education.	3.959	4.043	-.989	.912
9	The lack of quality instructional courseware will limit spread of educational discs.	3.481	3.700	-.403	1.000
14	Given the availability for purchase of a videotape recorder/player and a videodisc player . . . an individual interested in a use for instruction, training, and other nonentertainment applications will be more inclined to purchase the videodisc system when it is: 2/3 the price of a videotape system.	3.609	3.722	-.117	1.043
Educational Media: Computer-Based Instruction					
5[a]	Special hardware for editing, encoding, and playback of interactive programming will be developed and in some use.	3.633	3.800	-.729	.951
2[a]	Branching, nonlinear programs will be available.	3.755	3.904	-.610	.969

[a]Relevant to Navy training requirements.

Table 4 (Continued)

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Educational Media					
Computer-Based Instruction (Continued)					
7	Noninstitutional education areas will have substantial growth because of interactive videodisc terminals.	3.319	3.353	-.390	1.002
8[a]	Use of on-line computer terminals for computer-assisted instruction will be supplemented by programmed videodiscs.	3.646	3.722	-.131	1.041
4[a]	Videodisc technology will heavily interact with microprocessor technology for educational applications.	3.688	3.750	-.038	1.055
Texts					
2[a]	The educational sector will use some audiovisual forms of instruction to supplant texts.	4.140	4.310	-.610	.969
Audiovisual					
2[a]	Compared to present levels of separate AV usage: motion film will be in much less use.	3.681	3.854	-.683	.958
6[a]	Combinations of audio, video, still frame, random-access, high-density storage on videodisc will change education production techniques.	3.941	4.074	-.616	.968
7[a]	Videodisc growth will depend upon the growth of audiovisual media usage generally, including tape and film.	3.880	4.022	-.523	.982
Library Applications					
5[a]	Displays other than the standard TV screens will be in use.	3.941	4.058	-.756	.947

[a]Relevant to Navy training requirements.

Table 5

Round Four Prediction Statements Indicating Tendency Toward Disagreement

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Cultural Impact					
7	Given the availability of standardized disc materials on a world scale, foreign programming exchange will increase significantly over present levels.	3.706	3.960	+.621	1.154
5	Videodisc will be dangerous to individual rights since, in archival applications, any information about individuals and groups can be kept indefinitely and can be accessible almost instantly.	2.231	2.026	+.694	1.165
4	There will be a movement toward individual isolation from the larger mass of society.	2.240	2.000	+.727	1.170
Entertainment Aspects					
8	The videodisc will be the principal medium for popular recording artists.	3.208	3.231	+.016	1.063
15	Videodisc entertainment popularity will be similar to audio records in that popularity is directly proportional to the amount of public exposure to the actual program.	3.917	4.111	+.315	1.108
14	The disc will open new vistas for entertainers in experimental or minority-appeal types of programming, some of it produced on relatively low budgets.	3.804	4.025	+.588	1.149
11	Programming quality will be directly related to rising production costs in terms of cultural/intellectual quality.	3.646	3.833	+.648	1.158
2	Inexpensive videodisc programs (based on market price projections) will compete effectively with weaker prime-time television programming.	3.392	3.531	+.934	1.201
Mass Communication					
5	Printed matter for periodicals and for reference materials encoded on the videodisc will enhance the home reference center concept.	3.784	4.000	+.022	1.064
8	Madison Avenue will introduce new products into the home via videodisc.	4.100	4.342	+.335	1.111
7	Broadcast schedules will increase live, perishable "now" events.	3.980	4.182	+.3[illegible]	1.116
12	Motion pictures will be advertised through give-away videodisc trailers.	3.149	3.154	+.541	1.142
9	Political campaign literature and newsletters will be mailed to constituents via videodisc.	3.367	3.531	+.827	1.185
13	Sunday papers will include videodisc reports of previous week's news and sports events.	2.740	2.571	+.987	1.209

Table 5 (Continued)

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Technology					
9[a]	Computerized videodisc centers will be accessable by telephone.	2.816	2.842	+.089	1.074
8	High resolution videodisc systems with large screens will be used in small "convenience" theatres.	3.549	3.725	+.268	1.101
14	The advent of new photosensitive materials and higher powered, shorter wave length, internally modulated lasers (solid-state or gas) will make low-cost home recording feasible.	3.022	2.964	+.381	1.118
7[a]	Advanced in videotape technology will provide competition with the videodisc.	3.796	4.040	+.501	1.136
1[a]	Devices such as film projectors, videotape, and photographic equipment for nonbroadcast applications will have begun to be replaced by full feature videodisc players geared to electronic display.	3.615	3.848	+.528	1.140
16[a]	Advances in magnetic recording techniques, primarily in magnetic media, will continue to improve the practicality of mass program distribution on magnetic formats.	3.347	3.462	+.574	1.147
11[a]	By the end of the 10-year period, playback and record-and-play systems with no moving parts will be introduced.	2.653	2.545	+.694	1.165
Commercial Applications					
3[a]	Standardization (compatible systems) will be achieved through pressure by international standards.	2.327	2.130	+.049	1.068
16	Videodisc and ancillary manufacture will be "big business" by 1978.	1.981	1.763	+.095	1.075
25[a]	Videodisc will be in widespread use by 1986.	3.885	4.077	+.115	1.078
24[a]	Videodisc players and software will be available on the general market by the final months of 1978.	3.694	3.842	+.155	1.084
13	Specifically, the consumer costs of shorter duration programs (e.g., video "record albums") will exceed current market projection.	3.163	3.139	+.175	1.087
8[a]	Optical gas scanning (freeze frame, electronic address, random access) videodisc players will evolve as the leading system.	3.865	4.000	+.282	1.103
27	Given the beginning availability . . . the period in which . . . videodisc players will reach 2 million or more will be: 1982-83.	3.260	3.583	+.282	1.103

[a]Relevant to Navy training requirements.

Table 5 (Continued)

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Commercial Applications (Continued)					
2[a]	Standardization (compatible systems) will be achieved through negotiations by major manufacturers of non-compatible systems.	3.140	3.300	+.303	1.107
29	Given . . . a videotape recorder/player and a videodisc player . . . a consumer interested in entertainment will be more inclined to purchase a videodisc player when it is: the same price as a videotape system.	2.469	2.263	+.395	1.120
30	Given . . . a videotape recorder/player and a videodisc player . . . a consumer interested in entertainment will be more inclined to purchase a videodisc player when it is: 2/3 the price of a videotape system.	3.471	3.531	+.395	1.120
11[a]	The costs of all videodisc players will decrease from current market projections.	3.706	3.925	+.621	1.154
9	Program production costs, in certain instances, will be very low, resulting in a healthy diversity of available software.	3.558	3.860	+.674	1.162
14	Specifically, the consumer costs of longer duration programs (e.g., full-length movies) will exceed current market projections.	3.347	3.294	+.694	1.165
Quality of Education					
6[a]	The videodisc will be used to educate the disadvantaged better than is currently possible.	3.860	4.024	+.056	1.069
5[a]	Only the brighter minds will be able to make full use of the discs.	1.824	1.481	+.315	1.108
7	Educators will press for expanded availability of players.	3.884	4.136	+.807	1.182
Noninstitutional Education					
6	Teaching to the family unit through the family-owned videodisc system will be an important facit of noninstructional education.	2.918	2.867	+.608	1.152
5	Noncredit home education (i.e., health education, paralegal education, consumer education, and other courses designed to improve day-to-day coping) will have reached significant usage levels.	3.531	3.737	+.641	1.157

[a]Relevant to Navy training requirements.

Table 5 (Continued)

Prediction Number	Prediction Statement	Mean	Median	Standard (Z Score)	Std. Dev. (M=1.061, σ=.150)
Educational Feasibility					
12	Given the beginning availability of at least one videodisc system and a sufficient quantity and diversity of accompanying programs intended for instruction, training, and other non-entertainment uses by the close of 1977, the period in which the accumulated number of videodisc players of that same or compatible system in the hands of users will reach 200,000 or more will be: 1986.	4.279	4.609	+.102	1.076
6	High cost of program development will inhibit initial quality of disc programs.	3.551	3.815	+.135	1.081
8	The lack of centralized curricula will limit spread of educational discs.	3.333	3.619	+.661	1.160
4[a]	Educational discs will be available only after other mass consumption markets have been established.	2.904	2.833	+.874	1.192
Educational Media:					
Computer-Based Instruction					
6[a]	Response mechanisms such as touch panels or keyboards will be added to the players.	3.696	3.868	+.076	1.072
1[a]	Videodisc interactive systems, based on computer memories, will be in frequent use.	3.102	3.156	+.534	1.141
Television					
3	Cable TV and ITFS (Instructional Television Fixed Service) as storage retrieval media will be in much greater use.	3.553	3.600	+.129	1.080
2	Open-circuit, on-the-air ITV will be substantially reduced.	3.340	3.500	+.734	1.171
1	Classroom use of videodisc will be widespread by 1986.	3.265	3.444	+.953	1.204
Audiovisual					
3[a]	Compared to present levels of separate AV usage: Videotape will be in much less use.	2.804	2.708	+.109	1.077
1[a]	Various audiovisual media forms, i.e., motion (film, tape), stills (graphics, film strips, etc.), consolidated on videodisc will have made TV presentations the rule, not the exception.	3.510	3.750	+.142	1.082
Library Applications					
6[a]	Instant hardcopy printouts will have been developed for videodisc archival storage.	3.729	3.900	+.042	1.067
9[a]	Pure reference books will be accessible only on videodisc.	1.860	1.500	+.056	1.069

[a]Relevant to Navy training requirements.

Table 5 (Continued)

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Library Applications (Continued)					
2[a]	Paper and magnetic tapes will be much less used compared to present levels of usage.	2.804	2.550	+.235	1.096
7	Far greater circulation of aural/visual materials than ever seen with phono-disc and film, between institutional terminals and individual users.	3.569	3.656	+.262	1.100
8	Library bookstacks will be supplemented by videodiscs with single-frame images of art work, and photographic representations of news (historical) events and sports events.	3.412	3.594	+.947	1.203

[a]Relevant to Navy training requirements.

Table 6

Round Four Prediction Statements Indicating Disagreement

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Cultural Impact					
3	No resultant political impact is seen.	2.923	2.857	+1.565	1.296
Entertainment Aspects					
6	If costs remain competitive, the videodisc will be more popular than the audiodisc.	3.415	3.684	+1.240	1.247
1	Initial competition will be between the open circuit broadcast of movies, new movies in theatres, and videodisc programming.	2.882	2.625	+1.319	1.259
Mass Communications					
4	There will be some loss (0-25%) of the current market of print-symbol methods of information dissemination: hardcover, paperback publications.	2.816	2.708	+1.053	1.219
3	There will be some loss (0-25%) of the current market of print-symbol methods of information dissemination: other periodicals.	3.041	3.077	+1.087	1.224
1	There will be some loss (0-25%) of the current market of print-symbol methods of information dissemination: Daily "volatile" periodicals (newspapers).	2.260	1.974	+1.206	1.242
2	There will be some loss (0-25%) of the current market of print-symbol methods of information dissemination: Weekly "volatile" periodicals.	2.714	2.471	+1.206	1.242
11	TV previews will be bound into TV Guides as videodiscs.	2.980	3.000	+1.412	1.273
Commercial Applications					
15	Videodisc ownership will be limited to upper economic households and institutions.	3.020	3.250	+1.060	1.220
7[a]	Standardization (compatible systems) will not have been achieved by 1986.	2.760	2.500	+1.399	1.271
20	The unauthorized duplication of videodisc software will be immense.	2.863	2.471	+2.064	1.371
Institutional Education: Role of the Teacher					
2	Educators will resist implementation of the videodisc.	3.346	3.559	+1.053	1.219
Educational Feasibility					
3	Videodiscs will be available only in high volume topics (1000+).	2.840	2.800	+1.160	1.235

[a]Relevant to Navy training requirements.

Table 6 (Continued)

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Educational Feasibility (Continued)					
11	Given the beginning availability of at least one videodisc system . . . intended for instruction, training, and other nonentertainment uses by the close of 1977, the period in which . . . videodisc players . . . in the hands of users will reach 200,000 or more will be: 1982-83.	3.622	3.800	+1.373	1.267
1	Standardization will be a deciding factor in the educational use of videodisc.	3.647	3.975	+1.446	1.278
10	Given the beginning availability of at least one videodisc system . . . intended for instruction, training, and other nonentertainment uses by the close of 1977, the period in which . . . videodisc players . . . in the hands of users will reach 200,000 or more will be: 1979-80.	2.375	2.056	+1.692	1.315
13	Given the availability for purchase of a videotape recorder/player and a videodisc player . . . an individual interested in a use for instruction, training and other nonentertainment applications will be more inclined to purchase the videodisc system when it is: the same price as a videotape system.	2.711	2.406	+1.984	1.359
2	Regardless of standardization, videodisc will be in widespread educational use by 1986.	3.288	3.500	+2.197	1.191
7	Inherent disc recording and copying limitations will limit availability of educational discs.	3.000	3.083	+2.250	1.399
Educational Media:					
Texts					
1[a]	Texts will be replaced by videodiscs in some cases (0-25%).	3.021	3.071	+1.120	1.229
Audiovisual					
4[a]	Compared to present levels of separate AV usage: Microfilm will be in much less use.	2.860	2.722	+1.233	1.246
5[a]	Compared to present levels of separate AV usage: Filmstrips will be in much less use.	3.429	3.694	+1.313	1.258
Library Applications					
3[a]	Computerized dial access libraries will be developed.	3.412	3.705	+1.053	1.219
1	Archival storage of specific library materials on discs will be common.	3.157	3.182	+1.080	1.223
4	Library stacks will be on disc as well as paper with paper somewhat receding in importance.	2.800	2.591	+1.226	1.245

[a]Relevant to Navy training requirements.

Table 6 (Continued)

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Library Applications (Continued)					
10	By 1986, special applications such as library usage (other than for loan) of videodiscs will still be very limited.	3.551	3.806	+1.319	1.259

Table 7

Round Two Prediction Statements Meeting High Agreement Criterion

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Cultural Impact					
6[a]	There will be regional and international exchanges of videodisc program material.	4.233	4.565	-.274	1.020
1[a]	Time to get to the cultural consumer will be slow.	4.289	4.600	-.069	1.058
Entertainment Aspects					
10	Unrestricted censorship on videodisc will eliminate the present motion picture theatre.	1.523	1.457	-2.381	.628
9	There will be a reduction in paid attendance, possibly to zero, at most cultural events; e.g., dance, drama, music.	1.556	1.400	-1.860	.725
11	There will be pornography applications of videodisc software.	4.489	4.717	-1.555	.856
1[a]	The concept of home "edutainment" centers will be largely accepted.	4.239	4.500	-.666	.947
4[a]	Present commercial TV audiences will have been eliminated.	1.636	1.380	-.435	.990
Mass Communications					
7	Local broadcast stations will be eliminated.	1.578	1.400	-1.548	.783
Technology					
12[b]	Large-screen display technology will be in use by 1986.	4.341	4.333	-2.284	.645
8[b]	Cost effectiveness will largely determine videodisc applications.	4.542	4.700	-2.086	.683
11[b]	Intensive efforts will be made to perfect flat electronic display.	4.326	4.467	-1.741	.747
Commercial Applications					
15[b]	The videodisc medium will prove to be a cost effective distribution medium for education, training, sales, and entertainment.	4.349	4.472	-1.548	.783
23	Software specifically produced for the videodisc will in turn stimulate the purchase of videodisc hardware.	4.217	4.300	-1.381	.814
Noninstitutional Education					
10[b]	Continuing professional education will be available on videodisc.	4.250	4.342	-1.397	.811
7	Handicapped and shut-ins will have more access to educational material.	4.267	4.375	-1.258	.837

[a]Did not meet the criterion for consensus.

[b]Relevant to Navy training requirements.

Table 7 (Continued)

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.061, s=.150)
Noninstitutional Education (Continued)					
8[a]	Noncredit educational pursuits, such as "how to" discs, will be widely seen.	4.295	4.543	-.897	.904
Educational Media: Audiovisual					
6[b]	Overall use of audiovisual formats will increase.	4.468	4.596	-2.064	.687

[a]Did not meet the criterion for consensus.

[b]Relevant to Navy training requirements.

Table 8

Round Three Prediction Statements Meeting High Agreement Criterion

Prediction Number	Prediction Statement	Mean	Median	Standard (Z) Score	Std. Dev. (M=1.086, s=.178)
Cultural Impact					
1[a]	Videodisc will cater to special interest audiences.	4.267	4.667	+.393	1.156
Entertainment Aspects					
8[b]	There will be stereo sound via videodisc.	4.698	4.806	-3.219	.513
3	One method of reaching the mass audience will be the "Book [disc] of-the-Month" direct mail approach.	4.209	4.225	-2.117	.709
2	Publishing houses will produce (by contract or in-house) and publish directly for the disc.	4.205	4.225	-1.988	.732
Commercial Applications					
26[b]	Standardization will be achieved by most manufacturers taking licenses for one system.	4.233	4.200	-2.668	.611
25[b]	If two commercially viable systems emerge, the less expensive version will be used more frequently in the home--the higher quality one will be used institutionally.	4.225	4.237	-2.179	.698
8[b]	Magnetic tape devices will be in use where read/write capability is important.	4.190	4.250	-1.758	.773
3[a]	Standardization will be achieved by government action.	1.833	1.750	-.848	.935
Quality of Education					
4[b]	The impact of discs will allow an increase in learning if educators are willing to use it for that purpose.	4.419	4.565	-1.814	.763
Educational Feasibility					
4[a]	The distribution of discs will be more cost favorable than currently available capabilities such as video cassette and 16mm film.	4.159	4.543	+.584	1.190
Educational Media: Texts					
3[b]	The educational sector will use more audiovisual forms of instruction to supplement texts.	4.186	4.217	-1.808	.764

[a]Did not meet the criterion for consensus.

[b]Relevant to Navy training requirements.

Interpretation

Before attempting to interpret the final levels of agreement shown in Tables 3 through 8, the three aspects incorporated into the design of the DELPHI used in this project will be discussed. The first such aspect is the use of the "open format"; that is, a format where predictions and subsequent comments on those predictions are provided by the panel. Although each grouping of predictions was condensed into separate prediction statements by the design team and statements found to contain compound meanings were reframed, the bulk of responses belonged solely to the panel. Although a considerable mortality rate per questionnaire was expected due to the abnormal length of open-format questionnaires, this was not found to be the case. The design team considered a minimum of 51 percent participation per round to constitute a quorum. This percentage was exceeded by 10 percent in Round One, 15 percent in Round Two, 10 percent in Round Three, and 9 percent in Round IV.

The second aspect incorporated into the design of this DELPHI was the self-rate feature. Brown and Helmer (1964) reported that the use of self-appraised confidence ratings is a powerful tool for increasing the reliability of group estimates. Dalkey, Brown, and Cochran (1969), reported a high correlation between confidence ratings and the ability of a diverse test group to accurately answer almanac-type questions. The confidence rating was assumed therefore to accommodate the wide range of disciplines in this DELPHI panel. Reliable estimates regarding a technological issue, for example, might be expected from an electrical engineer but not necessarily from a marketing executive or media specialist. However, due to the senior levels of competence throughout the panel, self-ratings were expected to be quite high on all predictions. This was confirmed by the relatively small number of missing cases per item (a function of the confidence rating), and the mean confidence ratings per questionnaire. As indicated previously, those probability ratings with confidence ratings of 2 ("uncertain") or 1 ("very uncertain") on the Likert-type scale were not considered in analyzing group response. The range of missing cases and mean of missing cases per item in Questionnaire II was 0-12 and 4.9 respectively; in Questionnaire III, 0-10 and 3.9; and in Questionnaire IV, 0-10[1] and 3.3. The decrease in missing cases per questionnaire was possibly due to the increased panelist familiarity with the subject matter afforded by extended time between questionnaires. Of the statements included in the analysis of group response, the mean confidence ratings for Questionnaires II, III, and IV were 4.188, 4.163, and 4.111 respectively.

The third aspect incorporated in this DELPHI was the "probability: ever" rating incorporated in Questionnaire IV in response to panelist commentary in earlier rounds. Although no significant change was observed in low probability ratings generated in Round Four relative to those generated in previous rounds, several panel members did exercise the probability: ever option on many items.

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[1]Prediction 6 under Mass Communication in Questionnaire IV was misunderstood by 26 panel members and was not included in the analysis of missing cases.

Prediction Statements Indicating Consensus

The prediction statements indicating consensus (Tables 3, 7, and 8) may be summarized according to their categories as follows:

1. Cultural Impact: No high consensus responses.

2. Entertainment Aspects: Film and broadcast producers will place greater restrictions on videodisc rights; there will be four-channel sound via videodisc; there will not be a reduction in paid attendance to "out of home" events; publishing houses will produce directly for videodisc.

3. Mass Communications: Videodisc periodicals will merge motion, still, print, and nonprint media; local broadcast stations will not be eliminated; videodiscs will assume an "economically self-regenerating" position by 1986.

4. Technology: Videodisc systems will incorporate random access to 10^{15}-10^{17} bit memories, disc changers, CW and solid state lasers, flat electronic display, and large screen display.

5. Commercial Applications: Standardization will be achieved by market place elimination; motion picture reissues on disc will be less popular than videodisc periodicals; magnetic tape will be used where read/write capability is important; if two systems emerge, the less expensive version will be used in homes and the more expensive version will be used in institutions; the relative costs of all video record-playback machines (tapes, cassette) will decrease.

6. Quality of Education: The gulf between highly educated and under-educated societies will not have widened; videodiscs will allow an increase in learning if educators are willing to use it for that purpose.

7. Institutional Education: Videodiscs will facilitate the growth of open learning, individualized instruction, and audiovisuals used in non-linear instructional design.

8. Noninstitutional Education: The physically limited will have more access to education; continuing professional education will be presented on discs; off-campus secondary education will be seen.

9. Educational Feasibility: Nonentertainment users will be more inclined to purchase videodisc hardware and software if the cost remains less than comparable videotape hardware and software.

10. Educational Media: Freeze frame, frame address, and fast random access will be necessary and sufficient for interactive branching systems; videodiscs will engender more use of audiovisuals to supplement texts; overall use of audiovisual formats will increase.

11. Library Applications: No high consensus responses.

An analysis of those prediction statements that indicated consensus (Tables 3, 7, and 8) indicated that several focused on (1) systems design strategies, (2) cost strategies, or (3) market impact.

System Design Strategies. Statements relevant to systems design referred to both commercial and educational hardware and software.

1. The Navy can expect four discrete channels of audio to be standard by 1986 (Table 3, Entertainment Aspects No. 7).

2. Stand-alone videodisc changers with random-access memories of 10^{15}-10^{17} bits, with matrix information regimens will be available (Table 3, Technology Nos. 12 and 13).

3. CW and solid-state lasers will be in use (Table 3, Technology No. 3).

4. Accelerated efforts to perfect flat electronic display and large-screen display (already in some commercial use for video projection systems) will complement videodisc technology (Table 7, Technology Nos. 11 and 12).

5. Standardization of videodisc systems probably will not have been achieved by 1986, but standardization will be continuing by the marketplace process of elimination, possibly as manufacturers take licenses for one system over the other (Table 3, Commercial Applications No. 4 and Table 8, Commercial Applications No. 26).

6. Commercial and educational environments will continue to accommodate magnetic tape devices where a read/write capability is important (Table 8, Commerical Applications No. 8).

7. Audiovisuals on optical videodiscs will be used in nonlinear instructional design strategies (Table 3, Institutional Education No. 3).

8. Freeze frame, frame address, and fast random access will be necessary and sufficient for interactive branching systems (Table 3, Educational Media, CBI No. 3).

Cost Strategies.

1. The relative costs of all video record-playback machines (tape, cassette) will decrease (Table 3, Commercial Applications No. 10).

2. Given the availability for purchase of a videotape recorder/player or a videodisc player and a sufficient quantity and diversity of programs for each, an individual interested in instruction, training, or other nonentertainment applications will be more inclined to purchase the videodisc system when its price is one third of that of a videotape system (Table 3, Educational Feasibility No. 15).

3. Given the inexpensive mastering and replication costs of videodisc software compared to tape and film formats, the distribution of discs will be more cost favorable than videotapes/cassettes or 16mm film (Table 8, Educational Feasibility No. 4).

4. If two videodisc systems emerge, the less expensive version will be used in homes and the more expensive version (i.e., one combined with microprocessor technology) will be used in institutions (Table 8, Commercial Applications No. 25).

Market Impact.

1. By 1986, more than five percent of American homes will own videodisc systems (Table 3, Commercial Applications No. 17).

2. Educational uses of videodisc technology will probably lag behind disc availability. This may be partially due to the initial focus by many videodisc manufacturers on the commercial market (Table 3, Quality of Education No. 2).

3. By 1986, the educational sector will use more audiovisual forms of instruction to supplement text (Table 8, Educational Media, Texts No. 3).

Prediction Statements Indicating Tendency Toward Consensus

Several of the prediction statements indicating tendency toward consensus (Tables 4, 7, and 8) also focussed on systems design and cost strategies and market impact. Relevant statements from Table 4 are summarized below.

Systems Design Strategies.

1. Greater precision and efficiency in maintenance technology (i.e., aircraft maintenance) will be seen utilizing audiovisual material stored on videodiscs (Technology No. 2).

2. By 1986, video dropout problems will have been largely eliminated by improved materials technology (Technology No. 15).

3. Because the videodisc as a storage device incorporates a wider selection of media, combinations of audio, motion video, film, still frame, random access, and high density storage on videodisc will change education production techniques (Educational Media, AV No. 6).

4. The videodisc will stimulate the formation of new or reorganized specialized groups of design and production personnel (Institutional Education, Role of the Teacher No. 4).

Cost Strategies.

1. Home video recorders will not be preferred for purchase over videodiscs (Commercial Applications No. 22).

2. Since aural and visual material selected for videodiscs are subject to the same cost considerations as other media, videodisc programming quality will be directly related to rising production costs in terms of production quality (Entertainment Aspects No. 12).

Market Impact.

1. It will be "more than likely" (M = 3.558) that there will be more than one accepted video player format by 1986 but not more than three (Commercial Applications No. 19).

2. Shipboard nonresident uses of videodiscs as program delivery systems will increase as the separate use of motion film as a delivery system decreases over the next decade (Educational Media, AV No. 2).

3. Videodisc growth will depend on the growth of audiovisual media generally (Educational Media, AV No. 7).

Panel members exercised the "probability: ever" option on a number of predictions that they felt were unlikely to occur by 1986 or were likely to go either way by 1986. Means for "probability: ever" ratings and estimated dates of occurrence for these statements were compared. Of the items deemed unlikely to occur by 1986, Entertainment Aspects, No. 5 (elimination of small audience TV programming) was considered by 14 panel members to possibly go either way (M = 2.571) by 1994. Noninstitutional Education No. 1 (shift from centralized to decentralized) was given a probable rating (M = 3.800) by the year 1999 by 15 members. Of the items conceded to go either way by 1986, Institutional Education, Role of the Teacher No. 3 (teachers as resource advisors) was considered probable (M = 4.000) by 1990 by 12 panel members and No. 5 under this category (a new form of learning/counseling center) was considered probable (M = 4.090) by 1991 by 11 panel members. The above ratings and estimates of occurrence should be regarded with caution because of the small number of panel members who exercised the "probability: ever" option for the given items and the increasing uncertainty of any estimate beyond 10 years due to unforeseen technological and cultural changes.

Prediction Statements Indicating Tendency Toward Disagreement

The systems design strategies, cost strategies, and market impact of prediction statements indicating a tendency toward disagreement (Z = 0.000 - +1.000) were not analyzed because the Z-scores of the statements did not clearly indicate agreement or disagreement among the panel.

Prediction Statements Indicating Disagreement

Since the panel included persons from a variety of disciplines, identifying areas where they disagreed (Table 6) is probably as important as identifying those where they agreed. Thus, statements on which there was marked disagreement may be summarized under the various topic categories as follows:

1. Cultural Impact: No resultant political impact is seen (No. 3).

2. Entertainment Aspects: Videodisc will be more popular than existing forms of entertainment (movies and audiodiscs) (No. 6).

3. Mass Communications: Videodisc will compete with print-symbol media (Nos. 1-4).

4. Technology: No disagreement.

5. Commercial Applications: Videodisc use will be limited to upper economic households and institutions (No. 15); standardization will not be achieved (No. 7).

6. Quality of Education: No disagreement.

7. Institutional Education: Educators will resist videodisc use (No. 2).

8. Noninstitutional Education: No disagreement.

9. Educational Feasibility: Videodisc will be available only in high volume topics (No. 3); videodisc will be in widespread educational use (No. 2).

10. Educational Media: Videodisc will compete with microfilm and filmstrips (AV Nos. 4 and 5).

11. Library Applications: Dial access and archival storage on videodisc will be developed (Nos. 1 and 3).

Several bimodal frequency distributions were observed as Z-scores increased beyond +1.000 (Table 6). This suggests that, in addition to the normal individual opposition to group opinions, possible camps of opposing opinion existed within the panel. For example, the panel could not agree whether or not (1) compatible systems will have been achieved by 1986, (2) standardization of systems would be a deciding factor in the educational use of videodiscs, (3) educators would resist implementation of videodiscs--for fear of their jobs--or press for expanded availability of videodiscs, (4) videodiscs would be available only in high volume topics (1000+), and (5) special library applications (other than for loan) of videodiscs would still be very limited. The responses of individual panel members were compared with 13 bimodal distributions, all with Z-scores greater than +1.000 (disagreement), in an effort to identify camps of opposing opinion. Although it was not within the scope of this research to seek a correlation between responses to the items and individual backgrounds and disciplines, the evidence collected suggests that neither corporate developers, engineers, media practitioners, nor educators reflected strong professional bias for or against videodisc development.

Table 9 presents a typical example of individual responses to the bimodal distributions. The prediction stated that initial competition will be between the open circuit broadcast of movies, new movies in theatres, and videodisc programming. As shown, members of all four disciplines were found among both peaks of the distribution. Moreover, it was noted that two corporate developers from the same firm had differing opinions. After similar examinations of all the bimodal distributions, it was concluded that they resulted from the content of the statements rather than from the biases of individuals with different stakes in the future of videodisc technology.

Table 9

Distribution of Group Responses

	Likert Scale				
Discipline Represented	1	2	3	4	5
Corporate Developers (8)	2	3	1	2	-
Educators (12)	2	5	-	3	2
Engineers (11)	1	5	-	4	1
Media Practitioners (22)	2	5	3	8	4
Total (53)	7	18	4	17	7

Note. There were two missing cases on this item.

CONCLUSIONS

The distribution of responses on a normal curve using Z-score cut-off scales to determine levels of agreement provided an appropriate statistical definition of consensus for this DELPHI exercise.

The findings of this study indicate that the 10-year outlook for videodisc as a Navy training device is favorable. Further, the Navy can expect more than one videodisc format to be available for use by 1986, presumably both optical and capacitance systems. Both systems will be capable of providing linear playback of up to 30 minutes of prerecorded motion programming with two, and possibly four, discrete audio channels per disc. Institutional needs will be better served by the use of optical videodisc systems, since such systems incorporate capabilities for both motion and still frames which are appropriate for interaction, multimedia environments, and individualized instruction.

An increasing use of audiovisuals, both in and out of the classroom, is also expected over the next 10 years. The videodisc is an audiovisual storage medium. Thus, if videodisc growth depends on the continued growth of audiovisual media, the anticipated incorporation of videodisc in audiovisual systems will increase the use of both audiovisual and videodisc systems. The diffusion of videodisc systems into environments other than instruction can be expected to reach sufficient magnitude to warrant immediate investigations of using videodisc technology for increasing instructional productivity and reducing instructional costs.

RECOMMENDATIONS

The following is recommended:

1. The Navy should assist in the development of optical videodisc technology, since the functional capabilities of optical videodiscs are more suited to Navy training requirements than other disc formats. Only optical videodiscs can combine media on a single format, thereby providing a basis for inexpensive branching strategies. Optical videodisc players scheduled for consumer release in 1977 may require hardware adaptations to meet Navy training needs. Thus, required adaptations of consumer players should be ascertained, and a contingency plan should be developed in anticipation of an educational/instructional optical videodisc player expected to be released at a later date. Investigations into appropriate uses of subsequent videodisc innovations should parallel the Navy's investigations of available videodisc hardware.

2. The Navy should increase R&D investments in audiovisual instruction in response to the unique videodisc opportunity.

3. Investigations should be initiated to determine the relative instructional effectiveness of motion, still, color graphic, text, and audio media and to develop a methodology that accounts for individual differences and establishes optimal combinations of media appropriate for individual student's aptitude, background, and cognitive styles.

4. A systems approach that addresses the procedures, facilities, and costs of videodisc software should be developed. Consideration of videodisc as an instructional medium must take into account the steps of instructional systems development that require use of intermediary media for validation, evaluation, and revision before a disc is mastered and replicated for distribution. The selection of intermediary media is a function of the disc characteristics and instructional strategies required. Costs must be considered for the preparation of intermediary media needed for instructional development procedures. Therefore, a systems approach to videodiscs as instructional delivery systems should address two critical issues: (1) appropriate use of the disc for delivery and (2) selection of appropriate instructional development media.

5. R&D should be invested in the use of videodisc technology for storage of personnel file information, technical reference information, and videodisc automated hard copy transfer that can be updated periodically.

6. Operational investigations should be initiated on the potential use of videodisc technology for distributed (especially shipboard) consolidation of file and technical reference information, presentation of entertainment, and delivery of instruction. Accordingly, inquiries into the acquisition by the Navy of optical videodisc mastering and replication facilities should be made so that existing programming, appropriately redesigned programming, and newly developed programming suitable for videodisc delivery can be transferred to disc format.

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